SPECIFICATION FOR

METHODS AND SYSTEMS FOR IMPROVING A USER'S VISUAL PERCEPTION

5   OVER A COMMUNICATIONS NETWORK

CROSS REFERENCES TO RELATED APPLICATIONS

This application is a continuation-in-part of pending

U.S. Patent Application Serial No. 09/642,506, Lyon & Lyon

10   Docket No. 251/228, filed on August 17, 2000, which claims

the benefit of pending Israeli Patent Application Serial No.

133758, filed on December 27, 1999.

BACKGROUND OF THE INVENTION

15   1.   FIELD OF THE INVENTION

The invention relates generally to the field of

improving vision, more specifically, to identifying and

improving visual perception and acuity abilities, and

improving the visual perception process and neural

20   performance of a user, over a communications network.

2.   BACKGROUND INFORMATION

Human eyesight is a product of two separate processes

that work together to form images for a person to "see".

One of these processes, herein referred to as the physical

25   component, concerns the physical structure of the various

elements of the eye and how incoming light is manipulated

and processed by the eye. Defects in the shape of the

cornea, the retinal wall, or the optic nerve can impair or

destroy the functionality of a person's eye and thus impair

5   or eliminate the ability to perceive images. Fortunately,

defects in the cornea of a person can be corrected through

the use of glasses, contacts, or surgery such as laser

keratotomy. Likewise, defects in the retina of a person are

often repairable by surgery.

10   The second process involved in allowing humans to see

images is herein referred to as the neurological component.

This component concerns neural processing in the brain and

how the brain analyzes information sent from the eyes to

produce an image for that person to see. A person can

15   likewise have a number of defects in this component of the

visual process, such as reduced visual acuity, reduced

sensitivity for spatial contrast, reduced vernier acuity,

spatial distortion, abnormal spatial interactions and

impaired contour detection.

20   The physical component and the neurological component

work together to form images that a person sees, or more

precisely, that a person *perceives*. The term "perceives" is

preferred because although the physical component may

capture certain details, defects in the neurological

component may distort and destroy these details, therefore,
the image that is "seen" by the person may not be exactly
what is captured by the eyes. Consequently, the image that
is *perceived* may differ in detail from the image that is

5   *seen* by the eyes. Thus, for the sake of preciseness, the
overall process of human eyesight is herein referred to as
the visual perception process.

Defects in the neurological component of a person's
visual perception process cannot be remedied through the use

10 of corrective lenses or surgery, therefore, alternate
techniques must be employed to alleviate or correct visual
defects to this neurological component.

For example, a common defect in the neurological
component of the visual perception process is a condition

15 known as amblyopia. This is a perception defect where the
brain incorrectly interprets and processes visual
information it receives from the eyes, despite the fact that
the physical structure of the eyes may be unimpaired. When
addressing amblyopia in children, one approach to correcting

20 defects in the neurological component is to occlude the non-
amblyopic, dominant eye and "force" the brain to make
greater use of the amblyopic eye. This approach generally
strengthens the amblyopic eye and increases its visual
acuity. But a significant shortcoming of this approach is

that this method is typically only useful in children under

the age of nine, and beyond that age the method generally

provides insignificant results. Furthermore, occlusion of

the non-amblyopic eye is accomplished through the use of an

5   unsightly eye patch, and this often results in social and

emotional problems for children. The eye patch frequently

causes skin irritation as well.

Amblyopic observers suffer from many or all of the

neurological defects mentioned above, such as reduced visual

10 acuity, reduced sensitivity for spatial contrast, reduced

vernier acuity, spatial distortion, abnormal spatial

interactions and impaired contour detection. Amblyopes may

also have abnormally high degrees of intrinsic noise, which

may form the basis of their abnormal contrast sensitivity

15 function.

SUMMARY OF THE INVENTION

The invention addresses a need for methods and
apparatus that provide proper identification of visual and
neurological abilities related to the condition of the

5   neurological component of the brain, such as visual
perception abilities. In addition, the invention provides
methods and apparatus for improving visual and neurological
performance, such as visual perception ability, and
developing improved neural performance in the brain and

10   nervous system. Furthermore, all of these methods are
carried out over a communications network such as the
Internet.

According to one aspect of the invention, a
communications network based system for identifying and

15   improving visual and neurological abilities is provided,
comprising a client terminal and a host server
communicatively coupled to one another, and a host storage
device comprising a computer-readable medium communicatively
coupled to the host server, wherein the host storage device

20   has stored therein one or more sequences of processor
executable instructions for identifying and improving visual
and neurological abilities.

According to another aspect of the invention, a method
for remotely identifying and improving visual and

neurological abilities comprises sending a plurality of

parameters from a host terminal to a client terminal, then

at the client terminal using the parameters to generate a

set of images, presenting the set of images on a display

5   screen, receiving an input from a user based on the user's

perception of the set of images, and generating a further

set of images based at least in part upon the parameters and

based at least in part upon the user input, then generating

and sending user performance data from the client terminal

10   to the host terminal, and finally analyzing the user

performance data at the host terminal to identify and

improve any visual and neurological abilities.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates one embodiment of a visual perception task image.

Figure 2 illustrates a second embodiment of a visual

5   perception task image.

Figure 3 illustrates further embodiments of the visual perception task image of Figure 2.

Figures 4A and 4B illustrate one embodiment of a visual perception task.

10   Figure 5 illustrates another embodiment of a visual perception task.

Figure 6 illustrates an embodiment of an overall network configured to carry out the methods of the invention.

15   Figure 7 is a flowchart depicting the methods of the invention from the perspective of the host server.

Figure 8 is a flowchart depicting an embodiment of how the host server selects a visual perception task session for a user.

20   Figure 9 is a flowchart depicting the methods of the invention from the perspective of the client terminal.

Figure 10 illustrates an embodiment of an apparatus configured to carry out the methods of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

1.   TERMINOLOGY

As used herein, the term "Visual Perception Task image"
or "VPT Image" refers to an image generated by the invention

5   for use in testing, treating, or improving a user's visual

perception process.

As used herein, the term "Visual Perception Task" or

"VPT" refers to one or more VPT images that are used alone

or in combination with each other to test or improve a

10   user's visual perception process.

As used herein, the term "Visual Perception Task

Session" or "VPT Session" refers to a plurality of VPTs that

are presented to a user to test or improve their visual

perception process. Each VPT Session is generally designed

15   to target a specific aspect of the visual perception

process.

2.   VISUAL PERCEPTION TASK IMAGES

Beginning with Figure 1, an embodiment of a Visual

20   Perception Task Image (VPT Image) of the invention is shown.

The VPT Image 100 of Figure 1 comprises a single target

Gabor patch 102 designed to activate neurons in the visual

cortex. It should be noted that the VPT Image 100 can take

the form of any visual stimulus, and is not limited to Gabor patches.

The Gabor patch 102 is a luminance pattern defined by a collection of odd (sine) and even (cosine) wave functions

5 with limited spatial extent (and/or temporal extent). These functions are referred to as Gabor functions. The Gabor functions include variables that describe the pattern orientation, wavelength (width of a single black-white cycle) and spread of the Gaussian envelope.

10 Gabor functions are significant because they have been shown to efficiently describe the shape of receptive fields in the mammalian visual system. Neurons in the primary visual cortex receive retinal inputs with weights distributed over space in a shape that fits the Gabor

15 function. In humans, it has been shown that visual pattern detection is performed by multiple localized filters, each covering a range of retinal space, orientations and wavelengths. The filters weigh visual input by a function that fits the Gabor function, each filter having its own

20 parameter set (location, orientation, wavelength). These detectors underlie both pattern detection and segmentation.

Another VPT Image 100 is illustrated in Figure 2, this time comprising a central target Gabor patch 102 flanked by two more Gabor patches 104 of similar orientation and

spatial frequency placed laterally of the central Gabor

patch.   In this embodiment, the target Gabor patch 102

preferably coincides with a fixation point of an observer

(the target patch 102 being fovean) sitting a distance of

5   about 0.5 - 2.5 meters from a display screen presenting the

VPT image.   The Gaussian envelope size ($\sigma = \lambda = 0.15°$) may be

such that at least one cycle is within a range of $\pm\sigma$ from

the Gaussian center. The carrier spatial frequency of the

Gabor patches may be 6.6 cycles per degree ($\lambda = 0.15°$) and

10   mask contrast may be 40%.   The distance d between the target

Gabor patch 102 and the flanking patches 104 may be 1.5λ.

The initial contrasts of the patches may be in the range of

8-50%, for example.   In short, each visual image is

characterized by a parameter comprising at least one of a

15   contrast, a spatial frequency, a distance between the

images, a local and global orientation, presentation time,

and possibly other parameters as well.

It should be noted that the invention comprises a

number of alternative embodiments of the VPT Images 100.

20   This is because many visual perception deficiencies exist,

and each deficiency generally requires a different set of

VPT Images 100 to address and improve it.   Therefore, the

invention employs a large number of different VPT Images 100

to improve many different types of visual perception

deficiencies.   These different VPT Images 100 use changes in

parameters such as contrast, contours, spatial frequency,

distance between the images, local and/or global

5   orientations of the images, and other attributes to develop

improved neurological function.   Because the VPT Images 100

are typically computer-generated images, they may also be

either static or dynamic.

Furthermore, the VPT Images 100 are not restricted to

10   Gabor patches, but rather any kind of visual image,

including straight lines, curved lines, or other shapes.

The particular VPT Image 100 used is selected based upon

which neurological functions require improvement.

Accordingly, the embodiments shown in Figures 1 and 2 are

15   for purposes of illustration only, and are not meant as

limitations on the invention.

Variations of the VPT Images of Figures 1 and 2 not

shown are also used by the invention.   For example, another

variation of the VPT Image 100 of Figure 1 may consist of

20   sequentially adding one or more flanking Gabor patches 104

that are similar in appearance to the target Gabor patch

102.   And for the VPT Image 100 of Figure 2, a variation may

consist of rotating the local orientations of the Gabor

patches 102 and 104, as well as their global orientation.

These alternate variations of the VPT Image 100 of Figure 2

are shown in Figure 3.

3.   VISUAL PERCEPTION TASKS

5   A Visual Perception Task (VPT) comprises one or more

VPT Images 100 that are presented to a user in sequence,

wherein at least one of the VPT Images 100 generally

includes a target. As used herein, the term "target" refers

to a specific image that the user is expected to focus on or

10   detect, such as a Gabor patch or some other visual stimulus.

When two or more VPT Images 100 are used in a VPT, generally

less than all of the VPT Images 100 used will contain the

target. For example, if two VPT Images are used, one VPT

Image will have the target while the other VPT Image will

15   not. The VPTs vary, thus there may be a single static or

dynamic VPT Image used in a VPT, or there may be two or more

VPT Images displayed in sequence.

        Turning to Figures 4A and 4B, an example of a VPT is

shown. In this example, the VPT uses two VPT Images 100.

20   The VPT begins with a user focusing on a target area, which

is generally the center of the display screen. Some form of

marker may be displayed prior to the VPT Images 100 being

shown to aid the user in focusing on the target area. Next,

the two VPT Images 100, shown in Figures 4A and 4B, are

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shown to a user in sequence. The first VPT Image 100

appears on screen for a short duration of time, then no

image is shown for a short duration of time, and finally the

second VPT Image is shown for a short duration of time. One

5   of the two images will contain the "target", appearing in

the target area the user is focusing on, that the user is

expected to perceive. In the VPT of this example, the

target appears in the second image, which is Figure 4B.

      After the images are shown, the user is asked to

10   provide an input based upon his or her perception of the VPT

Images 100 that were presented. For example, the user can

be asked to indicate whether he or she perceived the target.

The appropriate user input in this example then would be to

acknowledge that the second image contained the target. The

15   user can provide this input through a variety of mechanisms,

for instance by answering a yes/no question, a multiple

choice question, a true/false question, a right/left

question, or other similar questions. The user provides the

input using an input device such as a computer keyboard or

20   mouse. Other input means, such as voice recognition, touch-

screens, joysticks, trackballs, computer pens, or touch-pads

can also be used. For some VPTs, such as those testing

perception of contours, the input may not be a response to a

question, but rather, the user may indicate a perceived

contour formed by the images using a mouse to outline the

contour.

Once the user inputs a response, the invention will

generate one or more further VPTs to present to the user

5   based at least in part upon the user's response to the

preceding VPT. For example, if the user was unable to

perceive the target in the preceding VPT, the further VPT

can be made so that the target is easier to perceive for the

user. Alternately, the further VPT can be designed to

10   maintain the same level of difficulty, thereby taxing the

user's visual perception process and further working the

user at the thresholds of their visual perception abilities.

The further VPTs are generated by varying one or more

parameters associated with the VPT Images 100. These

15   parameters include but are not limited to contrast, spatial

frequency, distance between images, local and global

orientation, and the duration of time an image is displayed.

Turning to Figure 5, another example of a VPT is

provided. This particular VPT is designed to evaluate the

20   initial level of performance of a user in regard to the

vernier acuity aspect of the visual perception process.

Four steps are shown, corresponding to four different VPT

Images that are presented to a user in sequence as described

above. The first VPT Image 100 comprises three horizontal

lines 500, 502, and 504 that are aligned vertically, as

shown in step 1.   In the subsequent VPT Images 100, steps 2

to 4, the middle vertical line 502 is gradually moved away

from the top vertical line 500 and bottom vertical line 504

5   in a horizontal direction.   At each step, the user provides

inputs that indicate whether he or she can perceive that the

middle vertical line 502 is offset from the top and bottom

lines 500 and 504.   When the user provides an input

indicating that he or she detects the offset, the invention

10   registers and stores this threshold level of vernier acuity.

Again, it should be noted that this is just one of many

possible embodiments of VPTs.

The administration of a series of VPTs designed to

target a specific aspect of the visual perception process is

15   referred to as a VPT Session.   For example, a series of VPTs

designed to improve a user's vernier acuity is referred to

as a VPT Session for vernier acuity.   Different VPT Sessions

are designed to target all of the different aspects of the

visual perception process, and the methods of the invention

20   utilize all of these different VPT Sessions.   Generally,

only one aspect of a user's visual perception process is

targeted for improvement at a time, accordingly, one VPT

Session is typically administered at each sitting.   However,

depending on time constraints, a single VPT Session can be

administered over the course of two or more sittings.

4.   COMMUNICATIONS NETWORK ARCHITECTURE

5   Turning to Figure 6, a network architecture configured

to carry out the methods of the invention is shown. The

methods of the invention can be performed using a host

server 600 and a client terminal 620. Host server 600 is a

computer system 602 or device on a network with server

10   software 601 configured to receive and answer requests for

information. Typically, computer system 602 is also

dedicated to storing data files and managing network

resources, including network traffic. Computer system 602

or device generally includes a processor 604 and a data

15   storage device 606, and is typically connected to a global

communications network such as the Internet 640.

         Host server 600, through processor 604, has access to

software 608 comprising sequences of instructions that cause

processor 604 to perform a number of acts in accordance with

20   the methods described herein. In an alternative embodiment,

host server 600 can also have access to a web page data

storage device 610 that can store Hypertext Mark-Up Language

(HTML) documents defining web pages for communicating with

users, including HTML documents generated for the VPT Images

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100. Web page data storage device 610 can also store

computer program scripts to generate web pages using an

Active Server Pages (ASP) specification or Common Gateway

Interface (CGI) specification.

5   Host server 600 also has access to a client database

612 that stores information concerning users of the system.

This information can include identification information and

data relating to a user's performance during past VPT

Sessions. In alternate embodiments, client database 612 may

10   reside outside host server 600, such as at client terminal

620.

          Client terminal 620 is a remote terminal that provides

an interface for a user to access host server 600. Client

terminal 620 is typically a computer system 622 or device

15   that is communicatively coupled to host server 600 by a

communications network, such as the Internet 640. Computer

system 622 generally includes a processor 624, a data

storage device 626, a display screen 628, an input device

630, and software 627 that comprises sequences of

20   instructions that cause processor 624 to perform a number of

acts in accordance with the methods described herein. An

exemplary computer system for use in either the host server

600 or client terminal 620 is described below with reference

to Figure 10.

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5.   METHODS FOR ADMINISTERING VISUAL PERCEPTION TASKS OVER

A COMMUNICATIONS NETWORK

5 HOST SERVER-SIDE METHODS

Turning to Figure 7, a flowchart depicting an

embodiment of a method of the invention is shown. The

flowchart illustrates how the method is carried out at host

server 600. Starting with step 700, host server 600 first

10 receives a request from client terminal 620 for access to a

VPT Session. This request is sent from client terminal 620

to host server 600 over a communications network such as the

Internet 640. For ease of reference, the Internet will be

the communications network referenced. It should be noted,

15 however, that any form of communications network may be

utilized by the invention.

Host server 600 can make itself accessible for such a

request from client terminal 620 by providing an Internet

website. Users can visit the Internet website using a web

20 browser such as Netscape Navigator (available at

www.netscape.com) or Microsoft Internet Explorer (available

at www.microsoft.com), or a specially developed web browser

may be used to access the site. Users can then directly

request access to a VPT Session from host server 600.

In step 702, an authentication routine is performed to determine whether the request from client terminal 620 is valid.   In other words, host server 600 determines whether the user that is trying to access a VPT Session is

5   authorized to do so.   Generally, host server 600 does this by sending a request over the Internet to client terminal 620 for a username and password.   The data then received from client terminal 620 in response to the username and password request is typically transmitted to host server 600

10   over the Internet in an encrypted format, or using certificates, which prevents unauthorized persons from viewing the data.

Moving to step 704, upon receiving the username and password data from client terminal 620, host server 600

15   compares that data to username and password data stored in client database 612.   If host server 600 determines that the user is authentic, the process continues at step 706.   If the user is deemed to be non-authentic, a message is sent to client terminal 620 informing the user that access to the

20   VPT Sessions is denied, as shown in step 718.   At that point, the user can be allowed to re-enter his or her username and password information a number of times. Generally, the number of times the user is permitted to re-enter the username/password information is limited to

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prevent users from trying to gain unauthorized access.

After a predetermined number of failed authentication

attempts, host server 600 will typically ignore further

requests from client terminal 620 for a predetermined length

5   of time.

In step 706, after host server 600 determines that the

username and password supplied are genuine, a VPT Session is

selected and an initial set of VPT Session parameters are

generated. Typically, these parameters are defined in

10 advance. The VPT Session, as well as the VPT Session

parameters, are generated according to the methods described

below with reference to Figure 8. The VPT Session

parameters define items such as contrast level, contours,

spatial frequency, distance between objects, target

15 placement, local and/or global orientations, and

presentation time for each of the VPTs and VPT Images 100

being used to test or improve the visual perception process

of a user. The process of generating further VPT Session

parameters during administration of the methods of the

20 invention is explained below with reference to step 716 of

Figure 7 and with reference to Figure 8.

Moving to step 708, the initial VPT Session parameters

are then delivered to client terminal 620 over the Internet

640. Software resident on client terminal 620 is configured

to receive the VPT Session parameters and use them to

dynamically generate VPT Images 100 and VPTs. The VPT

Session parameters transmitted can be encrypted, or can use

certificates, for security purposes so no person can

5 intercept the data. Once the parameters are delivered, the

VPT Session can be carried out solely at client terminal 620

without the need for further interaction with host server

600. This preferred configuration allows the VPT Session to

be administered to the user without delay or interruption.

10   Alternatively, the VPT Session parameters can be sent

as web pages in a format such as the Hyper-Text Markup

Language (HTML) format. The web pages sent will generally

be full screen pages, encompassing the entire viewable area

of the display screen rather than appearing within a frame

15 of a web browser.

In another alternative configuration, administration of

the VPT Session can be carried out primarily by host server

600, thus requiring data to be transferred back and forth

between host server 600 and client terminal 620 during the

20 session itself.

Moving to step 710, after the VPT Session has been

administered to the user, host server 600 receives a set of

user performance data from client terminal 620. The user

performance data is data relating to the user's performance,

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and can include some or all of the user inputs received by

client terminal 620 during administration of the VPT

Session. The user performance data is generated by client

terminal 620, and then sent back to host server 600 over the

5   Internet 640. This data can also be encrypted to prevent

unauthorized persons from viewing the data.

In step 712, host server 600 stores the user

performance data it receives from client terminal 620. The

user performance data is generally stored on a data storage

10   device, such as client database 612. The data may

alternatively be stored on data storage device 606. This

alternative may be preferred when, for instance, the

personal information and medical records of clients are to

be kept on a relatively secured storage device that is

15   separate from the storage device that is storing the

collection of user inputs. The data storage device 606 is

further described below with reference to Figure 10.

Moving to step 714, the host server 600 next analyzes

the user performance data to unearth any visual perception

20   deficiencies, and to determine the level of performance of

the user's visual perception process. Software 608 provides

instructions and data for processor 604 to carry out this

analysis. A weighted average score can also be calculated

for the user. This is typically done by comparing the user

performance data to data collected from persons with normal

vision (i.e. acceptable levels of performance for each of

the different aspects of the visual perception process),

which helps gauge the user's level of performance.

5   Generally processor 604 performs such comparison, with data

related to that of a normal observer typically being stored

in data storage device 606.

Moving to step 716, the invention then generates new

VPT Session parameters that can be used in the next VPT

10   Session, based at least in part upon the user performance

data that was received by host server 600, and based at

least in part upon the analysis conducted upon the user

performance data by processor 604. These new parameters

again define specific VPT Images 100 and VPTs to further

15   improve the user's visual perception ability based upon the

user's level of performance. Host server 600 uses software

608 to make these analyses and determinations. Software 608

contains instructions regarding how to generate parameters

for VPT Images 100 and VPTs that will further improve the

20   visual perception of a user based on levels of performance

during past VPT Sessions. Generally, these parameters are

then stored until the user requests another VPT Session.

In an alternative embodiment of the invention, client

terminal 620 downloads VPT Session parameters for a number

of users at one time. For instance, client terminal 620 may

be in communication with host server 600 for a period of

time, for example in the morning, to download VPT Session

parameters for a number of users. These users can be

5 persons who have scheduled appointments to access client

terminal 620 during that day. This eliminates the need for

constant or frequent on-line communications, and can also

eliminate the need for individual usernames and passwords

for users as the entity running the client terminal can

10 control who has access.

In this alternative, the sets of user performance data

generated during the numerous VPT Sessions administered to

all of the users can then be uploaded to host server 600 at

one time. The data upload can take place anytime, for

15 example during off peak hours, or even the next morning

during the same period of time when new VPT Session

parameters are being downloaded for that day's scheduled

users. It should be noted that the period of time during

which the uploading and downloading of data takes place can

20 occur at any time of the day.

In another alternative embodiment, the VPT Images 100

are preformed and selected, rather than being generated

dynamically. In such an embodiment, the VPT Session

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parameters comprise the specific VPT Images 100 themselves,

rather than defining the images.

SELECTING A VPT SESSION TO ADMINISTER

5   Turning to Figure 8, a flowchart is illustrated that

demonstrates how a VPT Session is selected.   There are two

forms of VPT Sessions available, an evaluation phase to

ascertain a user's visual perception ability, and a

treatment phase to improve the user's visual perception.

10   Accordingly, as shown in step 800, the first step in

selecting a VPT Session is to determine whether the user has

undergone the evaluation phase.   If an evaluation has not

been completed, the next step in the process is to move on

to step 802.   Otherwise, the flowchart will continue at step

15   810.

      Starting with the evaluation phase and step 802, a user

undergoes the evaluation to enable the invention to

ascertain the condition of the user's visual perception

process.   This data allows the invention to generate

20   effective VPTs that target the user's visual perception

deficiencies.   It also allows the invention to have a

baseline set of data to gauge whether the user's visual

perception is improving over the course of a particular VPT

Session and over time. The evaluation process can be

performed as often as necessary or desired.

   Moving to step 804, the invention analyzes any user

inputs from past VPT Sessions. This data provides

5 information that the invention can use in establishing

parameters that select VPT Images 100 and VPT Sessions to

use to evaluate the user's visual perception. For instance,

if particular aspects of the user's visual perception have

recently been evaluated, the invention can select a VPT

10 Session that evaluates a different aspect. Or if the user

inputs from past VPT Sessions show that the user is

deficient in a particular aspect of their visual perception,

the invention can select a VPT Session that further

evaluates that aspect to determine whether there has been

15 improvement or deterioration.

   Moving to step 806, a VPT Session is selected from a

first group of potential VPT Sessions. VPTs within each VPT

Session are used to collect data from the user regarding

different aspects of the user's visual perception process to

20 detect the existence of any physical or neural defects. The

invention uses VPTs to test for any one or all of the

following:

   reduced visual acuity,

   abnormal contrast sensitivity functions,

reduced vernier acuity,

spatial distortion,

abnormal spatial interactions,

impaired contour detection,

5   abnormally high degrees of intrinsic noise,

as well as other aspects of the user's visual

perception.

Moving to step 808, once the VPT Session has been

selected, the invention generates parameters for the VPT

10   Session. These parameters define the VPT Images 100 and

VPTs that are to be presented to the user, and in particular

control the difficulty of the VPTs as well as other

characteristics. Again, data from past VPT Sessions,

including VPT Session parameters generated in accordance

15   with step 716 of Figure 7 above, can be used in setting

these parameters.

Moving to step 810 and the treatment phase of the

invention, the invention can be used to improve various

aspects of the visual perception process of a user and

20   alleviate visual perception deficiencies. The flow of the

treatment phase is almost identical to that of the

evaluation phase.

Moving to step 812, user inputs from past VPT Sessions

are analyzed. Next, as shown in step 814, a VPT Session is

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selected from a second group of VPT Sessions. This second

group of VPT Sessions is different than the group described

for the evaluation phase. Here, the second group of VPT

Sessions comprises the following:

5   a lateral masking treatment VPT Session,

          an acuity treatment VPT Session,

          an elongated stimuli treatment VPT Session,

          a stereoscopic treatment VPT Session,

          and other treatment VPT Sessions.

10   Moving to step 816, as was the case for the evaluation

phase, once a VPT Session has been selected the invention

generates parameters that again define the VPT Images 100

and VPTs that are to be presented to the user. Data from

past VPT Sessions can be used in generating these

15   parameters, including VPT Session parameters generated in

accordance with step 716 of Figure 7 above.

CLIENT TERMINAL-SIDE METHODS

          Figure 9 is a flowchart illustrating how the methods of

20   the invention are carried out at client terminal 620.

Starting with step 900, client terminal 620 receives a

request for a VPT Session from a user. For example, a user

can arrive at client terminal 620 and enter a request for a

VPT Session using an input device, such as a keyboard, at

client terminal 620.   The process of requesting a VPT

Session generally comprises visiting a web site, such as a

home page or authentication page provided by host server

600, and entering a username and password.   The software

5   that requests the username and password may be located on

either host server 600 or client terminal 620.

Moving to step 902, the VPT Session request and

username/password information is sent from client terminal

620 to host server 600 over a communications network such as

10   the Internet 640.   Again, the Internet will be used herein

as the communications network.   This transmission of data

can be encrypted or use certificates to prevent others from

accessing the username and password information.

In step 904, client terminal 620 receives a response

15   from host server 600 that either allows or denies access to

a VPT Session.   The response is transmitted over the

Internet 640 and is sent after host server 600 has

determined if the username and password supplied are

authentic.   As shown in step 906, if the user is authentic

20   and access is granted, the process continues at step 908.

Alternately, if host server 600 determines that the user is

not authentic, access to a VPT Session is denied and the

process ends with a message to the user indicating the

denial of access.

Moving now to step 908, VPT Session parameters for the current VPT Session are delivered to client terminal 620 from host server 600. These VPT Session parameters are used to define the VPTs, and VPT Images 100, that are presented

5   to the user. The process of generating the VPT Session parameters was explained above with reference to steps 706 and 716 of Figure 7, and steps 808 and 816 of Figure 8.

Client terminal 620 has software residing on it configured to administer VPT Sessions to a user, and

10   generally only requires VPT Session parameters from host server 600 to deliver the VPT Session. The software can be sent to client terminal 620 in any of a number of ways, including by Internet download, or via installation off of a magnetic or optical disk.

15   In step 910, the invention calibrates the user's visual perception. The visual perception ability of a user can vary from day to day based on a variety of factors such as stress, energy level, fatigue, previous meals, time spent in front of a computer screen or television, and many others.

20   Therefore the invention will run one or more tests of the user's visual perception to see if their visual perception ability is diminished due to these types of factors.

Moving to steps 912 and 914, the invention stores the collected calibration data and updates the VPT Session

30

parameters downloaded during step 908. The parameters are

updated to compensate for any diminished visual perception

ability detected during the calibration step 910, thereby

making the current VPT Session more effective and efficient.

5   Moving to step 916, the VPT Session is started. The

VPT Session selected during the selection phase described in

Figure 8 is used.

In step 918, the invention generates one or more VPT

Images 100 using the VPT Session parameters. Again, the

10   parameters provided by host server 600 will be used to

generate the VPT Images 100 on the fly. In another

embodiment, the invention may use preformed VPT Images 100

and simply select which VPT Image 100 to use.

Moving to step 920, after the one or more VPT Images

15   100 have been generated, they are displayed on a display

screen. If there are two or more VPT images 100, they are

generally displayed sequentially, typically with a pause

between each of the VPT Images 100. For example and as

explained above, if there are two VPT Images 100, generally

20   the first VPT Image 100 is displayed for a duration of time,

then a duration of time passes where no image is shown, and

then the second VPT Image 100 is shown for a duration of

time. This routine for displaying VPT Images 100

constitutes one type of Visual Perception Task.   Other forms

of VPTs are also possible.

   During the VPT a target is shown in at least one of the

VPT Images 100.   Then, as shown in step 922, the invention

5   receives an input from the user indicating whether or not

the user correctly perceived the target.   This input from

the user is important because the invention uses the user

inputs to gauge a user's visual perception ability and to

analyze the user's performance over one or more VPT

10   Sessions.   The invention also uses the user inputs to adjust

the VPT Session parameters used in subsequent VPT Images

100.

   Moving to step 924, the invention determines whether

the user input demonstrates that the user has reached a

15   predefined goal.   This goal is set by the invention based on

a variety of factors, including how the user has performed

in previous VPT Sessions and during evaluation phases.   An

example of a goal can be to administer VPTs to the user

until a desired level of improvement has been achieved.

20   Moving to step 930, if the goal has not been met, the

invention generates new VPT Images 100 that are used in a

subsequent VPT, again based on the VPT Session parameters

(which can be modified as the VPT Session is administered).

The new VPT Images 100 are generally variations of the

previous VPT Images 100, wherein parameters such as

contrast, distance between objects, color, shape, size, or

other parameters are changed. The new parameters can vary

the difficulty level of the VPT that is displayed, generally

5   based at least in part upon the user's inputs and

performance over the preceding one or more VPTs.

For instance, if the user is having a difficult time

perceiving a target, the new parameters can make the next

VPT less difficult and closer to the user's threshold. The

10   user's threshold level generally corresponds to a point

where the user is first able to successfully complete a

given VPT. In addition, incorrect responses may also

trigger a buzzer or some other auditory or visual signal.

And if the user is consistently perceiving the target

15   correctly, the new parameters can make the next VPT more

difficult. The same VPT may be presented to a user a number

of times before moving on to the next VPT, to more

accurately gauge the user's performance for a given VPT.

Once the new parameters are chosen, the invention moves back

20   to step 918 and displays the next set of VPT Images 100.

Moving to step 926, after the goal has been reached,

the invention accumulates the inputs into the VPT Session

results and generated the user performance data. These

results can later be analyzed by the invention to ascertain

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the condition of the user's visual perception process, and

determine whether it is improving or regressing.

Moving to step 928, the invention determines whether

the entire VPT Session has been completed. If so, the user

5   performance data, including the accumulated user inputs, are

sent to host server 600 over the Internet 640 as shown in

step 932, and this particular VPT Session is ended. The

user performance data can be sent to host server 600 in an

encrypted format, or using certificates, to prevent

10 unauthorized persons from viewing the user input data. If

the VPT Session has not been completed, the invention moves

back to step 918 and new VPT Images 100 are generated to

continue the current VPT Session.

15 6.   HARDWARE OVERVIEW

Figure 10 is a block diagram of an exemplary computer

system 1000 upon which methods of the invention can be

implemented. The computer system of Figure 10 can be used

for host server 600, and/or for client terminal 620.

20   Computer system 1000 includes a bus 1002, or other

communication mechanism for communicating information, and a

processor 1004 coupled with bus 1002 for processing

information. Computer system 1000 also includes a main

memory 1006, such as a random access memory ("RAM"), or other

dynamic (or "volatile") storage device, coupled to bus 1002.

The main memory 1006 stores information and instructions

executed by processor 1004 during execution. Main memory

1006 also stores temporary variables or other intermediate

5   information during execution of instructions by processor

1006.

   Computer system 1000 further includes a read only memory

("ROM") 1008 or other static (or "persistent") storage device

(e.g., FLASH, PROM, EEPROM, etc.) coupled to bus 1002. The

10 ROM 1008 stores static information and instructions for

processor 1004. It is worth noting that one or more banks of

memory can comprise ROM 1008. A storage device 1010, such as

a magnetic disk or optical disk (or "hard disk", or "hard

drive"), or another form of persistent storage device, is

15 coupled to bus 1002. The storage device 1010 uses a computer

readable medium to store information such as data structures

and instructions, for example, accumulated user input data

from completed VPT Sessions, processor executable

instructions (i.e. software) configured to carry out the

20 methods described above with reference to host server 600 and

client terminal 620, and/or structures relating to the

operating system or application programs that use the

operating system.

Computer system 1000 is preferably coupled via bus 1002 to a display device 1012, such as a cathode ray tube ("CRT") or an active or passive-matrix display. The display 1012 presents images to an end-user, such as VPT Images 100. An

5   input device 1014, including alphanumeric and other keys, is coupled to bus 1002. The input device 1014 communicates information and command selections to processor 1004. Another type of user input device is cursor control 1016, such as a mouse, trackball, or cursor direction keys, for

10   communicating direction information and command selections to processor 1004 and for controlling cursor movement on display 1012. This input device 1014 typically has two degrees of freedom in two axes, a first axis (e.g., x) and a second axis (e.g., y), that allows the device to specify positions in a

15   plane.

According to an aspect of the invention, the processor 1004 in the computer system 1000 executes one or more sequences of instructions (i.e. software 1005), contained in main memory 1006. Such instructions are read into main

20   memory 1006 from another computer-readable medium, such as storage device 1010 or ROM 1008. The instructions can be executable object code or interpreted code that is processed by a run-time engine (e.g., Javascript).

Execution of the sequences of instructions contained in main memory 1006 causes processor 1004 to perform the methods of the invention as described herein, such as the methods described with reference to host server 600 and/or

5   client terminal 620 above.   In alternative embodiments, hard-wired circuitry can be used in place of or in combination with software instructions to implement the invention.   Thus, embodiments of the invention are not limited to any specific combination of hardware circuitry

10   and software.

The term "computer-readable medium" as used herein refers to any medium that participates in providing instructions to processor 1004 for execution.   Such a medium can take many forms, including but not limited to, non-

15   volatile media, volatile media, and transmission media.   Non-volatile media includes, for example, optical or magnetic disks, such as storage device 1010.   Volatile media includes dynamic memory, such as main memory 1006.

Transmission media includes coaxial cables, copper wire

20   and fiber optics, including the wires that comprise bus 1002. Transmission media can also take the form of acoustic or light waves, such as those generated during radio-wave and infrared data communications.

Common forms of computer-readable media include, a

floppy disk, a flexible disk, a hard disk, a magnetic tape,

or any other magnetic media, a CD-ROM, any other optical

media, punchcards, a paper-tape, any other physical media

5   with patterns of holes, a RAM, a ROM, a FLASH, or any other

memory chip or cartridge, a carrier wave as described

hereinafter, or any other media from which a computer can

read.

Various forms of computer-readable media can be

10   involved in carrying one or more sequences of one or more

instructions to processor 1004 for execution. For example,

the instructions can initially be carried on a magnetic disk

of a remote computer. The remote computer can load the

instructions into its dynamic memory and send the

15   instructions over a telephone line using a modem. A modem

local to computer system 1000 can receive the data on the

telephone line and use an infrared transmitter to convert

the data to an infrared signal. An infrared detector

coupled to bus 1002 can receive the data carried in the

20   infrared signal and place the data on bus 1002. Bus 1002

carries the data to main memory 1006, from which processor

1004 retrieves and executes the instructions. The

instructions received by main memory 1006 can optionally be

stored on storage device 1010 before or after execution by

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processor 1004.

Computer system 1000 also includes a communication

interface 1018 coupled to bus 1002. Communication interface

1018 provides a two-way data communication coupling to a

5   network link 1020 that is connected to a local network 1022.

For example, communication interface 1018 can be an

integrated services digital network ("ISDN") card or a modem

to provide a data communication connection to a corresponding

type of telephone line. As another example, communication

10   interface 1018 can be a local area network ("LAN") card to

provide a data communication connection to a compatible LAN.

Wireless links can also be implemented. In any such

implementation, communication interface 1018 sends and

receives electrical, electromagnetic or optical signals that

15   carry digital data streams representing various types of

information.

Network link 1020 preferable provides data

communication through one or more networks to other data

devices. For example, network link 1020 can provide a

20   connection through local network 1022 to a host computer

1024 or to data equipment operated by an Internet Service

Provider ("ISP") 1026. ISP 1026 in turn provides data

communication services through the Internet 1028. Local

network 1022 and Internet 1028 both use electrical,

electromagnetic or optical signals that carry digital data

streams.   The signals through the various networks and the

signals on network link 1020 and through communication

interface 1018, which carry the digital data to and from

5   computer system 1000, are exemplary forms of carrier waves

transporting the information.

Computer system 1000 can send messages and receive data,

including program code, through the network(s), network link

1020 and communication interface 1018.   In the Internet

10   example, a server 1030 might transmit requested code for an

application program through Internet 1028, ISP 1026, local

network 1022 and communication interface 1018 -- for example

using the FTP protocol.   In accordance with the invention,

one such downloaded application is executable software code

15   or computer configuration parameters that perform the methods

of the invention.

The received code can be executed by processor 1004 as

it is received, and/or stored in main memory 1006, storage

device 1010, or other non-volatile storage for later

20   execution.   In this manner, computer system 1000 can obtain

application code in the form of a carrier wave.

Thus, methods and systems for analyzing and improving

the visual perception process of a person have been

disclosed.   It should be noted that the disclosed methods

and systems are useful for improving the visual perception

of any person, no matter whether the person has normal or

abnormal visual perception. The invention can also be used

to improve vision of observers suffering from problems such

5   as amblyopia or dyslexia. Even persons with anatomical or

functional problems, such as macular degeneration, can

improve what vision they have with the methods and apparatus

of the invention.

While various embodiments of the invention have been

10 shown and described, it will be apparent to those skilled in

the art that numerous alterations may be made without

departing from the inventive concepts presented herein.

Thus, the invention is not to be limited except in

accordance with the following claims and their equivalents.